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January 26, 2006

Angela Reynolds, Environmental Planning Officer
City of Long Beach
Dept. of Planning & Building
333 Ocean, 7th Floor
Long Beach, CA 90802

Re: Long Beach Airport DEIR Comments

Dear Ms. Reynolds,

I have reviewed and prepared comments on the Long Beach Airport Terminal Area Improvement Project Draft Environmental Impact Report (DEIR), dated November 2005. In particular, I focused on Section 3.2 (Air Quality and Human Health Risk Assessment) and Appendix C to the DEIR, prepared by Camp, Dresser, and McKee, dated November 2, 2005. While the DEIR includes a lengthy analysis of air quality and health risk impacts, the results and conclusions are based on unreliable data. Further, key emission and exposure scenarios are omitted entirely. The DEIR air quality and health risk analyses are inadequate and do not provide decision makers with the necessary information for identifying significant impacts and the effectiveness of mitigation measures.

My detailed comments on the DEIR air quality and health risk assessment analyses and conclusions are presented below. My primary concern is that the DEIR is based on inadequate meteorological data, rendering the air quality impact analysis and human health risk assessment completely unreliable. In addition, the DEIR neglected acrolein acute hazard indices for passengers and prepared an inadequate analysis for on-airport workers. Atmospheric re-entrainment of particulate deposition on runways was also ignored in the DEIR, even though the Long Beach Airport is in an area with very high diesel and other small particulate emissions.

My comments are based on 25 years of professional experience performing air quality and toxics exposure analyses. I was the senior air quality modeler and air toxics program coordinator for the Santa Barbara County Air Pollution Control District, where I worked for approximately nine years. For the past 14 years I have been a private consultant, specializing in regulatory agency and litigation support. My clients include the California Attorney General's Office, the Los Angeles County District Attorney's Office, the California Office of Environmental Health Hazard Assessment, various air pollution control agencies, the California Air Pollution Control Officer's Association, and many private firms. I have prepared over 300 complete air toxics health risk assessments and over 1,000 air dispersion modeling analyses. I have successfully provided expert testimony in numerous Federal and State Court cases. My curriculum vitae is attached.

Following are my comments on the DEIR air quality and human health risk analyses:

## I. The Long Beach Airport Meteorological Data are Unacceptable for Air Dispersion Modeling with AERMOD

The DEIR assesses compliance with the CAAQS, NAAQS, local significance thresholds, and human health impacts using one year of meteorological data from the Long Beach Airport (1985).[1] The quality of these airport data quality are not acceptable for air dispersion modeling, particularly for a refined air dispersion model such as AERMOD. The DEIR, which relies on these data for air modeling, is therefore flawed.

For air dispersion modeling purposes, airport data are among the least desirable. Problems with data collection frequency, location of the meteorological sensors, and general quality of data are the primary concerns. The USEPA, in their Meteorological Monitoring Guidance for Regulatory Modeling Applications, summarizes these concerns about using airport data:

> For practical purposes, because airport data were readily available, most regulatory modeling was initially performed using these data; however, one should be ware that airport data, in general do not meet this guidance.[2]

The Long Beach Airport is comprised of concrete runways, parking lots, passenger terminals, and other structures associated with air travel activities. These surface and building characteristics in turn affect the boundary layer meteorology present at the airport.[3] In addition, landings, takeoffs, and idling of airplanes affect the site-specific conditions at the airport such that the meteorological conditions are not representative of the area surrounding the airport. The air model used in the DEIR, AERMOD, relies on the meteorological conditions from the airport to characterize downwind dispersion. Since these measurements are biased due to the airport activities, the offsite air concentration predictions are likewise biased.

The primary issue, however, is the quality of the meteorological data collected at Long Beach Airport. It is important to remember that the airport data are not collected with the thought of air dispersion modeling in mind. For example, Long Beach Airport conditions in 1985 were reported once per hour, based on a single observation (usually) taken in the last ten minutes of each hour. The USEPA recommends that sampling rates of 60 to 360 per hour, at a minimum, be used to calculate hourly-averaged meteorological data.[4] Air dispersion modeling requires hourly-averaged data, which represents the entire hour being modeled, and not only a snapshot taken in one moment during the hour.

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[1] Local significance thresholds are from SCAQMD Rule 1303, Table A-2.
[2] USEPA, Meteorological Monitoring Guidance for Regulatory Modeling Applications, EPA-454/R-99-05, February 2000, p. 1-1.
[3] Oke T.R., Boundary Layer Climates, Halsted Press, 1978, pp. 240-241.
[4] USEPA, p. 4-2.

In addition, data collected at Long Beach Airport are not subject to the system accuracies required for meteorological data collected for air dispersion modeling. The USEPA recommends that meteorological monitoring for dispersion modeling use equipment that are sensitive enough to measure all conditions necessary for verifying compliance with the NAAQS and CCAQS. For example, low wind speeds (down to 1.0 meter per second) are usually associated with peak air quality impacts – this is because modeled impacts are *inversely* proportional to wind speed. Following USEPA guidance, wind speed measuring devices (anemometers) should have a starting threshold of 0.5 meter per second or less.[5] And the wind speed measurements should be accurate to within plus or minus 0.2 meter per second, with a measurement resolution of 0.1 meter per second.[6]

The Long Beach Airport data used by the DEIR, rather than being measured in 0.1 meter per second increments, is based on wind speed observations that are reported in whole knots. This is evidenced by examining the meteorological data files used in the DEIR modeling analyses.[7] Every modeled hourly wind speed is a factor of 0.51 or 0.52 meter per second (the units required for input to the air dispersion model), which exists because one knot equals 0.51479 meter per second. The once-per-hour observations at Long Beach Airport (in whole knots, no fractions or decimals) were converted to meters per second and can therefore be back-converted to the whole knot measurements originally reported by the airport. Every once-per-hour observation in the 1985 Long Beach Airport meteorological data set was reported in whole knots.

To further exemplify the problem of using the airport data, the lowest wind speed included in the meteorological data files used in the DEIR modeling analyses is 1.54 meters per second. This equals three knots, which is the lowest wind speed reported by the airport. Any winds lower than three knots are reported as calms, and are thus excluded from the modeling analyses. There are 1,020 such calm hours in the 1985 meteorological data file used in the DEIR (there are also 460 missing hours in the data set). In no uncertain terms, the conditions most crucial for verifying compliance with the CAAQS, NAAQS, local significance thresholds, and human health significance criteria (low wind speeds) are being excluded from the DEIR analysis because of the choice to use the Long Beach Airport data.

Sensitive and accurate measurements of wind speeds are necessary for measuring winds down to 0.5 meter per second (about one knot), which can then be used as 1.0 meter per second in the air dispersion modeling analyses. There would be no need to label such low wind speed hours as calm, which will greatly increase the number of hours included in the modeling analyses. Again, it is these low wind speed hours which must be included in the modeling data set to verify compliance with the CAAQS, NAAQS, local significance thresholds, and significant human health impacts. The meteorological data used in the DEIR modeling includes no wind speed below 1.54 meters per second, and to compound the problem, lists the lowest wind speed observations as calms, which are then excluded from the model calculations.

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[5] Id., p. 5-2.
[6] Id., p. 5-1.
[7] I obtained the 1982 through 1985 Long Beach Airport (in SAMSON format) and converted the data into modeling format using PCRAMMET.

The exclusion of wind speeds less than 1.54 meters per second is exemplified in the artificially increased annual-average wind speed at the airport. The DEIR depicts the annual-average wind speed at the airport as 3.10 meters per second.[8] The SCAQMD, in their 1981 air modeling meteorological data sets, have measured annual-average wind speeds at Long Beach and Los Alamitos of 1.71 and 2.18 meters per second, respectively. Again, since modeled air concentrations (and health risks computed from these results) are inversely proportional to wind speed, the elimination of low wind speeds will result in underestimated impacts. This is a crucial flaw in the DEIR.

The Long Beach Airport should be required to collect pre-construction meteorological data for use in their project DEIR modeling. The airport, which is a major emission source of many air pollutants, should not be assessed for air quality and human health impacts using meteorological data collected with none of the quality assurances necessary for air modeling data.

That Camp, Dresser, and McKee consulted with SCAQMD on the use of meteorological data provides no degree of comfort whatsoever.[9] SCAQMD last developed new data sets for dispersion modeling in 1981 – about 25 years ago. Since that time, dozens of revisions have been made to the regulatory air modeling framework, including continuing refinement to models such as MPTER, ISCST, ISCST2, ISCST3, and now AERMOD. In fact, the greatest hurdle to users of AERMOD, now the USEPA Guideline Model for flat and complex terrain, is the unavailability of suitable meteorological data. And just because AERMOD can be run using a certain meteorological data set, does not mean that the results are reliable. To think that the 1985 Long Beach Airport meteorological data is suitable for use in AERMOD is delusional. In essence, the refined planetary boundary characterization capabilities of AERMOD are negated by the crude meteorological data chosen by the DEIR preparer.

The SCAQMD has been very forgiving in not requiring new emission sources to collect high quality meteorological monitoring for use in air dispersion modeling. And now that AERMOD is the preferred dispersion model, the SCAQMD (and other air districts) are finding that there is no acceptable data to use in air quality impact analyses and health risk assessments. The requirement to collect quality meteorological data before a project enters the permitting process is not unusual. Even smaller air regulatory agencies have been requiring pre-construction meteorological data for many years. As part of their PSD program, the Santa Barbara County (California) Air Pollution Control district requires at least one-year of pre-construction air quality and meteorological monitoring.[10] The Santa Barbara APCD meteorological monitoring requirements are specified in a detailed protocol that implements their PSD Rule.[11]

The Long Beach Airport air emissions are significant and are released in a complex arrangement of point, area, and volume sources – both at the surface and aloft. Using an antiquated and low-quality

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[8] DEIR, Appendix C, p. 4-4. For reference, 3.10 meters/second equals the DEIR listed value of 6.04 knots.
[9] DEIR, p. 3.2-8.
[10] Santa Barbara County Air Pollution Control District, Rule 803, Prevention of Significant Deterioration.
[11] Barbara County Air Pollution Control District, Air Quality and Meteorological Monitoring Protocol for Santa Barbara County, October 1990.

meteorological data set, for no other reason than to expedite the permitting process for the Airport, invalidates the entire air quality impact analysis. The DEIR should be deemed unacceptable because of this poor modeling practice, and not be revised and recirculated until the Long Beach Airport has collected at least one year of AERMOD-suitable meteorological data consistent with USEPA's Meteorological Monitoring Guidance for Regulatory Modeling Applications.

## II. The Choice of Using Only 1985 Meteorological Data is not Adequately Supported

The problems with using Long Beach Airport meteorological data notwithstanding, the DEIR air modeling is based on only one year of observations – 1985.[12] The DEIR focuses on one year of data to reduce excessive computational demands; however, the basis for how this year was chosen is incomplete and flawed. The DEIR choice of using 1985 is based on annual-average and one-hour average modeled VOC concentrations, while 24-hour impacts are not included in this analysis. Twenty-four hour averaging period impacts could be higher in other years, but the DEIR is silent on this possibility. Using only 1985 Long Beach Airport meteorological data provides no assurance that significant short-term CAAQS, NAAQS, local significance thresholds, or acute hazard indices have been adequately identified. All available years of meteorological data should be included in the modeling.

## III. Additional Air Modeling and Health Risk Assessment Information is Required

The DEIR discusses only the surface data preparation for the 1985 Long Beach Airport data set. In addition to surface meteorological parameters, AERMOD requires vertical profile data, including measurements of wind direction, wind speed, temperature, and the turbulence parameters characterizing the horizontal wind direction standard deviation (sigma theta) and the vertical wind speed standard deviation (sigma w) at specified levels above the ground.[13] No discussion of profile data for 1985 meteorological data exists in the DEIR.

Vertical profile data in AERMOD is used to calculate downwind dispersion for elevations corresponding to lofty plumes and pollutant releases. This is particularly important for modeling the impacts from aircraft exhaust during landings and takeoffs when the pollutants are released directly into elevated profiles. If the DEIR is using surface data to characterize these profiles, one of the major advantages of using AERMOD (the ability to have different meteorological data at numerous profiles) is defeated. The DEIR must address how they are modeling elevated profiles with AERMOD.

In addition to answering the meteorological issues above, the DEIR preparers and lead agency should make all air dispersion modeling and health risk assessment data available in electronic format – either CD-ROMs or DVDs, depending on the size of the data. These electronic data are imperative for allowing the public to prepare a detailed critique of what actually went into the DEIR. Also, having these data in electronic format will expedite the public review and reanalysis process.

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[12] DEIR, Appendix C, Attachment G.
[13] USEPA, User's Guide for the AMS/EPA Regulatory Air Model – AERMOD, EPA-454/B-03-001, September 2004, p. 3-55.

The DEIR should include an Appendix explicitly listing the electronic files used in preparing the air quality and health risk assessments, and state that these files are publicly available for the review process. The publicly available files should include:

- All AERMOD input and output files;
- All AERMET input and output files;
- All AERMAP input and output files;
- All EDMS input and output files;
- All DEM files used in obtaining receptor terrain elevations;
- All aerial photos, in DOQQ MrSID and other formats;
- All meteorological data – both raw and processed;
- All GIS maps, project files and attribute data (preferably in ArcGIS file format);
- All source layout and plot plans (preferably in ArcGIS or Surfer file formats);
- All emission calculation spreadsheets (preferably in Excel format);
- All health risk assessment calculation programs and spreadsheets;
- All toxicity data used in assessing acute, chronic, and excess cancer risks;
- All non-proprietary programs used, such as EDMS and AERMOD;
- A listing of all proprietary programs used, and their purpose in the DEIR.

## IV. Passengers and On-site Worker Acrolein Exposures Are Not Adequately Assessed

The DEIR did not assess acute acrolein exposures to passengers, stating that "their exposures to TACS are intermittent and short-term."[14] This type of exposure, however, is the reason the State of California specifically developed a one-hour reference level (REL) for acrolein.[15] By sidestepping an analysis of acrolein exposures for passengers, the DEIR has failed to identify a potentially significant human health impact. Passengers are exposed entering and exiting terminals, boarding aircraft, and waiting within terminals. The DEIR should be modified to evaluate the health impacts that acrolein exposures would pose to passengers, as it has done for all other populations.

While the DEIR does address acrolein exposures to on-site workers, the assessment methodology is based on occupational health and safety values, rather than California RELs.[16] This compromises the DEIR in two ways: 1) The acute exposures to on-site workers are underestimated; and 2) A useful reference to potential passenger exposures is clouded. The DEIR on-site worker exposure assessment used the 8-hour OSHA PEL for acrolein, which is 0.1 ppm (250 $\mu g/m^3$).[17] This value is over 13 times less stringent than the California one-hour REL for acrolein (19 $\mu g/m^3$), plus the exposure period can last eight times as long. Since eight-hour modeled concentrations are typically

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[14] DEIR, p. 3.2-13.
[15] The acute (one-hour) REL for acrolein is 19 $\mu g/m^3$. Consolidated Table of OEHHA/ARB Approved Risk Assessment Health Values, Updated August 23, 2004.
[16] DEIR Appendix C, p. 5-15.
[17] http://www.cdc.gov/niosh/idlh/107028.html

one-half or less the peak modeled one-hour values, using the OSHA PEL approach is actually over 25 times less stringent than the California one-hour REL for acrolein.

The DEIR identified an acute hazard index for on-site worker exposure to acrolein of 0.49 for the incremental 2020 Project.[18] Had the DEIR used the California one-hour REL for acrolein, instead of the eight-hour OSHA PEL, the hazard index for on-site workers would almost certainly be over 12 (an acute hazard index of 1.0 is significant). It is extremely likely that passengers would also be exposed to one-hour acrolein levels similar to this value. Even if passenger exposure is only one-tenth the level of on-site workers, the human health impact would be significant. Both the on-site worker and passenger acrolein exposures are likely significant human health impacts that should be properly addressed in the DEIR.

## V. Atmospheric Re-entrainment of Fallout Particulates Are Not Assessed

The Long Beach Airport is located in an area with elevated levels of PM10, PM2.5, and diesel particulate matter. These particles, due to a downward deposition flux, will settle on exposed surfaces such as cars, rooftops, vegetation, and runways. During the DEIR preparation phase, commenters noted that their homes and cars are often coated with particulates and films.[19]

Each time a plane (large or small) takes off, lands, or taxis about the runway, the potential exists for significant re-entrainment of deposited particulates back into the atmosphere. In essence, this creates a new source of emissions – stirring up particulates already deposited by regional point and area sources. A simple analogy is the leaf blower. The wind and turbulence caused by the blower can cause very high levels of particulates as the material that settled on the ground is redistributed back into the air. The large surface area of the airport runways and the mixing turbulence generated by aircraft could lead to significant emissions of such particles.

The DEIR should address the potential concern of re-entrained particles caused by airport activities. In addition, a network of particulate samplers, measuring black carbon, PM2.5, and PM10 should be installed to encompass the Long Beach Airport. The DEIR should also identify the need to measure atmospheric deposition of particulates at the airport. These deposition measurements, coupled with a network of particulate samplers and wind sensors, are necessary to quantify the true impacts from airport expansion activities.

## VI. EDMS has been Withdrawn from USEPA Guideline Model Status

The DEIR used the EDMS/AERMOD modeling system to estimate emission rates and resultant air concentrations from activities associated with the proposed airport expansion. Version 4.3 of EDMS was used, which includes version 02222 of AERMOD, a beta-testing edition which has since been replaced with the approved Guideline version 04300. The DEIR should discuss the consequences of using the outdated beta-testing version of AERMOD.

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[18] DEIR Appendix C, p. 5-58.
[19] DEIR, Appendix A.

In addition, the EDMS model, which was once part of Appendix A (preferred status) of the USEPA Guideline on Air Quality Models, has recently been withdrawn. The reasons for this withdrawal are discussed in the most recent Revisions to the Guideline on Air Quality Models.[20] In essence, the Federal Aviation Administration has decided to withdraw EDMS from the Guideline on Air Quality Models, Appendix A. The USEPA affirmed support for the removal of EDMS from Appendix A status, apparently because a complete model evaluation process had not been submitted. The DEIR, which uses EDMS, must discuss this change in model status and the implications this has on the reliability of significance determinations.

Thank you for the opportunity to comment on the Long Beach Airport DEIR.

Sincerely,

Camille Sears

Attachment: CV

[20] 40CFR 51, Revision to the Guideline on Air Quality Models: Adoption of a Preferred General Purpose (Flat and Complex Terrain) Dispersion Model and Other Revisions, Final Rule, November 9, 2005.

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## Summary

I have 25 years of regulatory and private-sector experience in air quality impact analyses, health risk assessments, meteorological monitoring, and geographic information systems. I specialize in litigation support; I have successfully provided testimony in numerous cases, both as an individual consultant and as part of a team of experts.

## Education

- M.S., Atmospheric Science, University of California, Davis, 1980.
- B.S., Atmospheric Science, University of California, Davis, 1978.

## Air Dispersion Modeling

- I am experienced in applying many different air dispersion models, including programs still in the development phase. I have prepared well over 1,000 air dispersion modeling analyses requiring the use of on-site or site-specific meteorological data. These runs were made with the USEPA ISC, OCD, MESOPUFF, INPUFF, CALPUFF, ISC-PRIME, AERMOD, COMPLEX-I, MPTER, and other air dispersion models.
- I prepared and submitted technical comments to the USEPA on beta-testing versions of AERMOD; these comments are being addressed and will be incorporated into the model and instructions when it is ready for regulatory application.
- I am experienced in performing air dispersion modeling for virtually every emission source type imaginable. I have modeled:
  Refineries and associated activities;
  Mobile sources, including cars, trains, airplanes, trucks, and ships;
  Power plants, including natural gas and coal-fired;
  Smelting operations;
  Area sources, such as housing tracts, biocides from agricultural operations, landfills, airports, oil and gas seeps, and ponds;
  Volume sources, including fugitive emissions from buildings and diesel construction combustion emissions;
  Small sources, including dry cleaners, gas stations, surface coating operations, plating facilities, medical device manufacturers, coffee roasters, ethylene oxide sterilizers, degreasing operations, foundries, and printing companies;
  Cooling towers and gas compressors;
  Diatomaceous earth, rock and gravel plants, and other mining operations;
  Offshore oil platforms, drilling rigs, and processing activities;
  Onshore oil and gas exploration, storage, processing, and transport facilities;
  Fugitive dust emissions from roads, wind erosion, and farming activities;
  Radionuclide emissions from actual and potential releases.
- I have extensive experience in modeling plume depletion and deposition from air releases of particulate emissions.
- As a senior scientist, I developed the Santa Barbara County Air Pollution Control District (SBAPCD) protocol on air quality modeling. I developed extensive modeling capabilities for the SBAPCD on VAX 8600 and Intel I-860 computer systems; I acted as systems analyst for the SBAPCD air quality modeling system; I served as director of air quality analyses for numerous major energy projects; I performed air quality impact analyses using inert and photochemical models, including EPA, ARB and private-sector models; I performed technical review and evaluating air quality and wind field models; I developed software to prepare model inputs consistent with the SBAPCD protocol on air quality modeling for OCD, OCDCPM, MPTER, COMPLEX-I/II and ISC.
- I provided detailed review and comments on the development of the Minerals Management Service OCD model. I developed the technical requirements for and

supervised the development of the OCDCPM model, a hybrid of the OCD, COMPLEX-I and MPTER models.

- I prepared the "Modeling Exposures of Hazardous Materials Released During Transportation Incidents" report for the California Office of Environmental Health Hazard Assessment (OEHHA). This report examines and rates the ADAM, ALOHA, ARCHIE, CASRAM, DEGADIS, HGSYSTEM, SLAB, and TSCREEN models for transportation accident consequence analyses of a priority list of 50 chemicals chosen by OEHHA. The report includes a model selection guide for adequacy of assessing priority chemicals, averaging time capabilities, isopleth generating capabilities, model limitations and concerns, and model advantages.
- I am experienced in assessing uncertainty in emission rate calculations, source release, and dispersion modeling. I have developed numerous probability distributions for input to Monte Carlo simulations, and I was a member of the External Advisory Group for the California EPA *Air Toxics Hot Spots Program Risk Assessment Guidelines, Part IV, Technical Support Document for Exposure Assessment and Stochastic Analysis*.

**Health Risk Assessment**

- I have prepared more than 300 health risk assessments of major air toxics sources. These assessments were prepared for AB 2588 (the Air Toxics "Hot Spots" Information and Assessment Act of 1987), Proposition 65, and other exposure analysis activities. More than 120 of these exposure assessments were prepared for Proposition 65 compliance verification in a litigation support setting.
- I reviewed approximately 300 other health risk assessments of toxic air pollution sources in California. The regulatory programs in this review include AB 2588, Proposition 65, the California Environmental Quality Act, and other exposure analysis activities. My clients include the California Attorney General's Office, the Los Angeles County District Attorney's Office, the SBAPCD, the South Coast Air Quality Management District, numerous environmental and community groups, and several plaintiff law firms.
- I am experienced in assessing public health risk from continuous, intermittent, and accidental releases of toxic emissions. I am experienced in generating graphical presentations of risk results, and characterizing risks from carcinogenic and acute and chronic noncarcinogenic pollutants.
- I am experienced in communicating adverse health risks discovered through the Proposition 65 and AB 2588 processes. I have presented risk assessment results in many public settings -- to industry, media, and the affected public.
- For four years, I was the Air Toxics Program Coordinator for the SBAPCD. My duties included: developing and managing the District air toxics program; supervising District staff assigned to the air toxics program; developing District air toxics rules, regulations, policies and procedures; management of all District air toxics efforts, including AB 2588, Proposition 65, and federal activities; developing and tracking the SBAPCD air toxics budget.
- I have prepared numerous calculations of exposures from indoor air pollutants. A few examples include: diesel $PM_{10}$ inside school buses, formaldehyde inside temporary school buildings, lead from disturbed paint, phenyl mercuric acetate from water-based paints and drywall mud, and tetrachloroethene from recently dry-cleaned clothes.

**Litigation Support**

- I have prepared numerous analyses in support of litigation, both in Federal and State Courts. I am experienced in preparing F.R.C.P. Rule 26(a)(2) expert reports and providing deposition and trial testimony (I have prepared eight Rule 26 reports). Much of my work is focused on human dose and risk reconstruction resulting from multiple air emission sources (lifetime and specific events).

- I am experienced in preparing declarations (many dozens) and providing expert testimony in depositions and trials (see my testimony history).
- I am experienced in providing support for legal staff. I have assisted in preparing numerous interrogatories, questions for depositions, deposition reviews, various briefs and motions, and general consulting.
- Recent examples of my work include:
  *DTSC v. Interstate Non-Ferrous; United States District Court, Eastern District of California (2002).*
  In this case I performed air dispersion modeling, downwind soil deposition calculations, and resultant soil concentrations of dioxins (TCDD TEQ) from historical fires at a smelting facility. I prepared several Rule 26 Reports in my role of assisting the California Attorney General's Office in trying this matter.
  *Akee v. Dow et al.; United States District Court, District of Hawaii (2003-2004).*
  In this case I performed air dispersion modeling used to quantify air concentrations and reconstruct intake, dose, excess cancer risk, and noncancer chronic hazard indices resulting from soil fumigation activities on the island of Oahu, Hawaii. I modeled 319 separate AREAPOLY pineapple fields for the following chemicals: DBCP, EDB, 1,3-trichloropropene, 1,2-dichloropropane, and epichlorohydrin. I calculated chemical flux rates and modeled the emissions from these fumigants for years 1946 through 2001 (56 years) for 34 test plaintiffs and 97 distinct home, school, and work addresses. I prepared a Rule 26 Expert Report, successfully defended against Daubert challenges, and testified in trial.
  *Lawrence O'Connor v. Boeing North America, Inc., United States District Court, Central District of California, Western Division (2004-2005).*
  In this case I performed air dispersion modeling, quantified air concentrations, and reconstructed individual intake, dose, and excess cancer risks resulting from approximately 150 air toxics sources in Los Angeles and Ventura Counties, California. I prepared these analyses for years 1950 through 2000 (51 years) for 173 plaintiffs and 741 distinct home, school, and work addresses. I prepared several Rule 26 Reports, and the case settled on the eve of trial in September, 2005. Defendants did not attempt a Daubert challenge of my work.
- I have prepared hundreds of individual and region-wide health risk assessments in support of litigation. These analyses include specific sub-tasks, including: calculating emission rates, choosing proper meteorological data inputs, performing air dispersion modeling, and quantifying intake, dose, excess cancer risk, and acute/chronic noncancer health effects.
- I have prepared over 120 exposure assessments for Proposition 65 litigation support. In these analyses, my tasks include: reviewing AB 2588 risk assessments and other documents to assist in verifying compliance with Proposition 65; preparing exposure assessments consistent with Proposition 65 Regulations for carcinogens and reproductive toxicants; using a geographic information system (Atlas GIS) to prepare exposure maps that display areas of required warnings; calculating the number of residents and workers exposed to levels of risk requiring warnings (using the GIS); preparing declarations, providing staff support, and other expert services as required. I have also reviewed scores of other assessments for verifying compliance with Proposition 65. My proposition 65 litigation clients include the California Attorney General's Office, the Los Angeles County District Attorney's Office, As You Sow, California Community Health Advocates, Center for Environmental Health, California Earth Corps, Communities for a Better Environment, Environmental Defense Fund, Environmental Law Foundation, and People United for a Better Oakland.

**Geographic Information Systems**

- ArcGIS: I am experienced in preparing presentation and testimony maps using ArcView. I developed methods to convert AutoCAD DXF files to ArcView polygon theme shape files for use in map overlays.

- I have created many presentation maps with ArcView using MrSID DOQQ and other aerial photos as a base and then overlaying exposure regions. This provides a detailed view (down to the house level) of where air concentrations and health risks are projected to occur.
- Using ArcView, I have created numerous presentations using USGS Topographic maps (as TIFF files) as the base on to which exposure regions are overlaid.
- MapInfo for Windows: I prepared numerous presentation maps including exposure isopleths, streets and highways, and sensitive receptors, labels. I developed procedures for importing Surfer isopleths in AutoCAD DXF format as a layer into MapInfo.
- Atlas GIS: I am experienced in preparing presentation maps with both the Windows and DOS versions of Atlas GIS. In addition to preparing maps, I use Atlas GIS to aggregate census data (at the block group level) within exposure isopleths to determine the number of individuals living and working within exposure zones. I am also experienced in geocoding large numbers of addresses and performing statistical analyses of exposed populations.
- I am experienced in preparing large-scale graphical displays, both in hard-copy and for PowerPoint presentations. These displays are used in trial testimony, public meetings, and other litigation support.
- I developed a Fortran program to modify AutoCAD DXF files, including batch-mode coordinate shifting for aligning overlays to different base maps.

**Ozone and Long-Range Transport**

- I developed emission reduction strategies and identified appropriate offset sources to mitigate project emissions liability. For VOC offsets, I developed and implemented procedures to account for reactivity of organic compound species for ozone impact mitigation. I wrote Fortran programs and developed a chemical database to calculate ozone formation potential using hydroxyl radical rate constants and an alkane/non-alkane reactive organic compound method.
- I provided technical support to the Joint Interagency Modeling Study and South Central Coast Cooperative Aerometric Monitoring Program. With the SBAPCD, I provided technical comments on analyses performed with the EKMA, AIRSHED, and PARIS models. I was responsible for developing emissions inventory for input into regional air quality planning models.
- I was the project manager for the Santa Barbara County Air Quality Attainment Plan Environmental Impact Report (EIR). My duties included: preparing initial study; preparation and release of the EIR Notice of Preparation; conducting public scoping hearings to obtain comments on the initial study; managing contractor efforts to prepare the draft EIR.
- I modified, tested, and compiled the Fortran code to the MESOPUFF model (the precursor to CALPUFF) to incorporate critical dividing streamline height algorithms. The model was then applied as part of a PSD analysis for a large copper-smelting facility.
- I am experienced in developing and analyzing wind fields for use in long-range transport and dispersion modeling.
- I have run CALPUFF numerous times. I use CALPUFF to assess visibility effects and both near-field and mesoscale air concentrations from various emission sources, including power plants.

**Emission Rate Calculation**

- I developed methods to estimate and verify source emission rates using air pollution measurements collected downwind of the emitting facility, local meteorological data, and dispersion models. This technique is useful in determining whether reported source emission rates are reasonable, and based on monitored and modeled air concentrations, revised emission rates can be created.

- I am experienced in developing emission inventories of hundreds of criteria and toxic air pollutant sources. I developed procedures and programs for quantifying emissions from many air emission sources, including: landfills, diesel exhaust sources, natural gas combustion activities, fugitive hydrocarbons from oil and gas facilities, dry cleaners, auto body shops, and ethylene oxide sterilizers.
- I have calculated flux rates (and modeled air concentrations) from hundreds of biocide applications to agricultural fields. Emission sources include aerial spraying, boom applications, and soil injection of fumigants.
- I am experienced in calculating emission rates using emission factors, source-test results, mass-balance equations, and other emission estimating techniques.

**Software Development**

- I am skilled in computer operation and programming, with an emphasis on Fortran 95.
- I am experienced with numerous USEPA dispersion models, modifying them for system-specific input and output, and compiling the code for personal use and distribution. I own and am experienced in using the following Fortran compilers: Lahey Fortran 95, Lahey Fortran 90 DOS-Extended; Lahey F77L-EM32 DOS-Extended; Microsoft PowerStation 32-bit DOS-Extended; and Microsoft 16-bit.
- I configured and operated an Intel I-860 based workstation for the SBAPCD toxics program. I created control files and recoded programs to run dispersion models and risk assessments in the 64-bit I-860 environment (using Portland Group Fortran).
- Using Microsoft Fortran PowerStation, I wrote programs to extract terrain elevations from both 10-meter and 30-meter USGS DEM files. Using a file of discrete x,y coordinates, these programs extract elevations within a user-chosen distance for each x,y pair. The code I wrote can be run in steps or batch mode, allowing numerous DEM files to be processed at once.
- I have written many hundreds of utilities to facilitate data processing, entry, and quality assurance. These utility programs are a “tool chest” from which I can draw upon to expedite my work.
- While at the SBAPCD, I designed the ACE2588 model - the first public domain multi-source, multi-pathway, multi-pollutant risk assessment model. I co-developed the structure of the ACE2588 input and output files, supervised the coding of the model, tested the model for quality assurance, and for over 10 years I provided technical support to about 200 users of the model. I was responsible for updating the model each year and ensuring that it is consistent with California Air Pollution Control Officer’s Association (CAPCOA) Risk Assessment Guidelines.
- I developed and coded the ISC2ACE and ACE2 programs for distribution by CAPCOA. These programs were widely used in California for preparing AB 2588 and other program health risk assessments. ISC2ACE and ACE2 contain "compression" algorithms to reduce the hard drive and RAM requirements compared to ISCST2/ACE2588. I also developed ISC3ACE/ACE3 to incorporate the revised ISCST3 dispersion model requirements.
- I developed and coded the "HotSpot" system - a series of Fortran programs to expedite the review of air toxics emissions data, to prepare air quality modeling and risk assessment inputs, and to prepare graphical risk presentations.
- I customized ACE2588 and developed a mapping system for the SBAPCD. I modified the ACE2588 Fortran code to run on an Intel I-860 RISC workstation; I updated programs that allow SBAPCD staff to continue to use the "HotSpot" system – a series of programs that streamline preparing AB 2588 risk assessments; I developed a risk assessment mapping system based on MapInfo for Windows which linked the MapInfo mapping package to the "HotSpot" system.
- I developed software for electronic submittal of all AB 2588 reporting requirements for the SBAPCD. As an update to the "HotSpot" system software, I created software that allows facilities to submit all AB 2588 reporting data, including that needed for risk prioritization, exposure assessment, and presentation mapping. The data submitted

by the facility is then reformatted to both ATDIF and ATEDS formats for transmittal to the California Air Resources Board.

- I developed and coded Fortran programs for AB 2588 risk prioritization; both batch and interactive versions of the program were created. These programs were used by several air pollution control districts in California.

**Air Quality and Meteorological Monitoring**

- I was responsible for the design, review, and evaluation of an offshore source tracer gas study. This project used both inert tracer gas and a visible release to track the onshore trajectory and terrain impaction of offshore-released buoyant plumes.
- I developed the technical requirements for the Santa Barbara County Air Quality/Meteorological Monitoring Protocol. I developed and implemented the protocol for siting pre- and post-construction air quality and meteorological PSD monitoring systems. I determined the instrumentation requirements, and designed and sited over 30 such PSD monitoring systems. Meteorological parameters measured included ambient temperature, wind speed, wind direction, sigma-theta (standard deviation of horizontal wind direction fluctuations), sigma-phi (standard deviation of vertical wind direction fluctuations), sigma-v (standard deviation of horizontal wind speed fluctuations), and sigma-w (standard deviation of vertical wind speed fluctuations). Air pollutants measured included $PM_{10}$, $SO_2$, NO, $NO_x$, $NO_2$, CO, $O_3$, and $H_2S$.
- I was responsible for data acquisition and quality assurance for an offshore meteorological monitoring station. Parameters measured included ambient temperature (and delta-T), wind speed, wind direction, and sigma-theta.
- In coordination with consultants performing air monitoring for verifying compliance with Proposition 65 and other regulatory programs, I wrote software to convert raw meteorological data to hourly-averaged values formatted for dispersion modeling input.
- Assisting the Ventura Unified School District, I collected air, soil, and surface samples and had them analyzed for chlorpyrifos contamination (caused by spray drift from a nearby citrus orchard). I also coordinated the analysis of the samples, and presented the results in a public meeting.
- Using summa canisters, I collected numerous VOC samples to characterize background and initial conditions for use in Santa Barbara County ozone attainment modeling. I also collected samples of air toxics (such as xylenes downwind of a medical device manufacturer) to assist in enforcement actions.
- For the California Attorney General's Office, I purchased, calibrated, and operated a carbon monoxide monitoring system. I measured and reported CO air concentrations resulting from numerous types of candles, gas appliances, and charcoal briquettes.

**Support, Training, and Instruction**

- For 10 years, I provided ACE2588 risk assessment model support for CAPCOA. My tasks included: updating the ACE2588 risk assessment model Fortran code to increase user efficiency and to maintain consistency with the CAPCOA Risk Assessment Guidelines; modifying the Fortran code to the EPA ISC model to interface with ACE2588; writing utility programs to assist ACE2588 users; updating toxicity data files to maintain consistency with the CAPCOA Risk Assessment Guidelines; developing the distribution and installation package for ACE2588 and associated programs; providing technical support for all users of ACE2588.
- I instructed approximately 20 University Professors through the National Science Foundation Faculty Enhancement Program. Instruction topics included: dispersion modeling, meteorological data, environmental fate analysis, toxicology of air pollutants, and air toxics risk assessment; professors were also trained on the use of the ISC2ACE dispersion model and the ACE2 exposure assessment model.
- I was the instructor of the Air Pollution and Toxic Chemicals course for the University of California, Santa Barbara, Extension certificate program in Hazardous Materials Management. Topics covered in this course include: detailed review of criteria and

noncriteria air pollutants; air toxics legislation and regulations; quantifying toxic air contaminant emissions; criteria and noncriteria pollutant monitoring; air quality modeling; health risk assessment procedures; health risk management; control/mitigating air pollutants; characteristics and modeling of spills and other short-term releases of air pollutants; acid deposition, precipitation and fog; indoor/occupational air pollution; the effect of chlorofluorocarbons on the stratospheric ozone layer. I taught this course for five years.

- I have trained numerous regulatory staff on the mechanics of dispersion modeling, health risk assessments, emission rate calculations, and presentation mapping. I provided detailed training to SBAPCD staff in using the HARP program, and in comparing and contrasting ACE2588 analyses to HARP.
- Through UCSB Extension, I taught a three-day course on dispersion modeling, preparing health risk assessments, and presentation mapping with Atlas GIS and MapInfo.
- I hold a lifetime California Community College Instructor Credential (Certificate No. 14571); Subject Matter Area: Physics.
- I have presented numerous guest lectures – at universities, public libraries, farm groups, and business organizations.

**Affiliations**

- American Meteorological Society (former president, Ventura/Santa Barbara County Chapter).

**Publications**

- To establish a legal record and to assist in environmental review, I prepared and submitted dozens of detailed comment letters to regulatory and decision-making bodies.
- I have contributed to over 100 Environmental Impact Statements/Reports and other technical documents required for regulatory decision-making.
- I prepared two software review columns for the *Journal of the Air and Waste Management Association*.

**Employment History**

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|---|---|
| • Self-Employed Air Quality Consultant | 1992 to 2006 |
| • Santa Barbara County APCD, Senior Scientist | 1988 to 1992 |
| • URS Consultants, Senior Scientist | 1987 to 1988 |
| • Santa Barbara County APCD, Air Quality Engineer | 1983 to 1987 |
| • Dames and Moore, Meteorologist | 1982 to 1983 |
| • UC Davis, Research Associate | 1980 to 1981 |

**Testimony History**

- People of the State of California v. McGhan Medical, Inc.
  Deposition: Two dates: June - July 1990
- People of the State of California v. Santa Maria Chili
  Deposition: Two dates: August 1990
- California Earth Corps v. Johnson Controls, Inc.
  Deposition: October 26, 1995
- Dale Anderson v. Pacific Gas & Electric
  Deposition: January 4, 1996
  Arbitration: January 17, 1996
- Adams v. Shell Oil Company
  Deposition: July 3, 1996
  Trial: August 21, 1996
  Trial: August 22, 1996

- California Earth Corps v. Teledyne Battery Products
  Deposition: January 17, 1997
- Marlene Hook v. Lockheed Martin Corporation
  Deposition: December 15, 1997
- Lawrence O'Connor v. Boeing North America, Inc.
  Deposition: May 8, 1998
- Bristow v. Tri Cal
  Deposition: June 15, 1998
- Abeyta v. Pacific Refining Co.
  Deposition: January 16, 1999
  Arbitration: January 25, 1999
- Danny Aguayo v. Betz Laboratories, Inc.
  Deposition: July 10, 2000
  Deposition: July 11, 2000
- Marlene Hook v. Lockheed Martin Corporation
  Deposition: September 18, 2000
  Deposition: September 19, 2000
- Tressa Haddad v. Texaco
  Deposition: March 9, 2001
- California DTSC v. Interstate Non-Ferrous
  Deposition: April 18, 2002
- Akee v. Dow et al.
  Deposition: April 16, 2003
  Deposition: April 17, 2003
  Deposition: January 7, 2004
  Trial: January 17, 2004
  Trial: January 20, 2004
- Center for Environmental Health v. Virginia Cleaners
  Deposition: March 4, 2004
- Lawrence O'Connor v. Boeing North America, Inc.
  United States District Court, Central District of California,
  Western Division. Case No. CV 97-1554 DT (RCx)
  Deposition: March 1, 2005
  Deposition: March 2, 2005
  Deposition: March 3, 2005
  Deposition: March 15, 2005
  Deposition: April 25, 2005
- Clemente Alvarez, et al, v. Western Farm Service, Inc.
  Superior Court of the State of California
  County of Kern, Metropolitan Division. Case No. 250 621 AEW
  Deposition: April 11, 2005

**Other Interests**

- I have a small urban farm: CCOF-certified organic since 1997, growing tangerines, figs, cantaloupes, apricots, plums, peaches, herbs, and bamboo.
- I'm also a food and garden writer for Edible Ojai and Edible Communities.